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THE

PSYCHOLOGICAL BULLETIN

GENERAL REVIEWS AND SUMMARIES

SENSATION—GENERAL

By MADISON BENTLEY

University of Illinois

De Laguna (2) protests against the frequent confusion of analytic and genetic sensations. She maintains that the infant begins (at birth) with a few sensory differences and gradually, under functional demands, acquires more. Her arguments are three: (1) development is presumably from the homogeneous to the heterogeneous, (2) Dewey's "new theory" of perception makes functional differentiation of the brain depend upon the differentiation of motor discharges, and (3) infantile behavior furnishes no evidence for the discrimination of colors, tones, and the like. The first argument has obvious limitations. It might as well be used to prove that the infant begins with a viscus or two and gradually acquires others. The author herself speaks, in another connection, of "the deceptive truth" that "the simple precedes the complex." The second and third arguments rest upon the assumption that behavior (even the behavior of the infant) supplies a complete and detailed index to the composition of mind. The article itself (in the second part) reveals the weakness of this assumption, where the admission is made that "sensation has no direct relationship at all to behavior" (p. 617). This part repeats the old contention that introspective analysis of a perception is impossible. Perception is a functional unit which can be changed but not analyzed. Sensation, a simple kind of "awareness" of quality (*cf.* James), is unique in so far as it is independent of other, more complex, functional systems.[1] The kind of analyst attacked by the article

[1] See Wundt, W., *G. d. p. Psychol.*, 6th ed., 1908, I, 400 ff.

may not find it easy to come to terms with a doctrine which rests upon the dogma—often beautifully illustrated but never substantiated by the facts—that perception depends upon organic movement; which ignores two or three competent accounts of introspection; and which uses the term "stimulus" almost as irresponsibly and variously as Dewey himself. The application to sensation of Professor Washburn's notion of attention as "suspended reaction" suggests a fruitful tempering of the behaviorist's doctrine.

The perennial problem of the relation of sensation to "sense data" and to physical objects is discussed by Broad (1) in his article on phenomenalism. The article is a criticism of B. Russell's position on knowledge of the external world. It has much more to say of the "sensory data of knowledge" than of the sensations of analytical psychology. Articles by Nunn (4), and Moore and Stout (3) are of the same sort. Robinson (5) traces the history of the doctrine of sensation and perception from Condillac to Maine de Biran, who gives it a voluntaristic turn by basing the perceptual functions upon effort and will. Spiller (6) finds no present evidence that the different forms of sensations are separately represented in the internal capsule, though he thinks that they probably are separated in the parietal lobe, each sensory area lying adjacent to a corresponding motor area.

REFERENCES

1. BROAD, C. D. Phenomenalism. *Proc. of Aristot. Soc.*, 1914–15, 15, 227–251.
2. DE LAGUNA, G. A. Sensation and Perception. *J. of Phil., Psychol., &c.*, 1916, 13, 533–547, 617–630.
3. MOORE, G. E., & STOUT, G. F. The Status of Sense-data. *Proc. of Aristot. Soc.*, 1914, 14, 355–406.
4. NUNN, T. P. *Proc. of Aristot. Soc.*, 1915–16, 16, 156–178.
5. ROBINSON, A. The Philosophy of Maine de Biran; the Way Out of Sensationalism. *Proc. of Aristot. Soc.*, 1914–15, 15, 252–270.
6. SPILLER, W. G. Remarks on the Central Representation of Sensation. *J. of Nerv. & Ment. Dis.*, 1915, 42, 399–418.

VISION—GENERAL PHENOMENA

BY EDWIN B. HOLT

Harvard University

During the past year the most important work on this subject has been done not in Germany nor in Europe, but in America, and not in the colleges or universities, but in those now rather numerous

laboratories which have been established, and which are maintained, by companies that are engaged in illuminating, photographic, and other similar industries. The introspective and "purely psychological" points of view figure on the whole less prominently, and in their stead we find a more competent physical and mathematical handling of the problems than has hitherto been the rule.

One of the most comprehensive papers of the year is that of Troland on "apparent brightness" (33). He defines *light* as "radiation 'evaluated according to its capacity to produce' apparent brightness"; for, "strictly speaking, light is not the stimulus to vision, but is vision itself." The author introduces a semi-physiological light unit, the *photon*, which "is that intensity of illumination upon the retina of the eye which accompanies the direct fixation, with adequate accommodation, of a stimulus of small area, the photometric brightness of which, as determined by the standard flicker comparison and a normal subject, is one candle per square meter, when the area of the externally effective pupil, considered as lying in the nodal plane of the eye, is one square millimeter. The intensity of a visual stimulus, expressed in photons may be called its *physiological intensity*." Such a definition raises the question as to what is a normal or average eye. The answer to this question will doubtless have to come from organic chemistry: meanwhile several practical rules for discovering the observers who have "an average eye" are given by Crittenden and Richtmyer (8), who emphasize "the fact that for accurate heterochromatic measurements a systematic choice of observers is essential."

Troland further points out six stages in the (optical and) physiological process which intervenes between the impact of radiation on the outer surface of the eye and "the generation of the consciousness of light. . . . With regard to the intra-ocular adventures of this radiation we know a little; concerning retinal response, very little; and concerning the visual brain process practically nothing." As to the first, indeed, there are nearly thirty factors which must be known in order to deduce the quantitative constitution of the retinal image, and the majority of these "have not been measured even roughly." Yet it is the retinal image which is the actual physiological stimulus. There is room for exact investigations.

The author believes that retinal stimulation is "photochemical, depends on molecular or atomic resonance, and probably involves changes in the degree of ionization of substances contained in the receptors." There are two independent retinal processes, thoes

of the rods and of the cones, respectively. "The selective response of the eye to radiation of different wave-lengths (visibility curve) depends principally upon the photochemical selectivity of the retina." Both rods and cones may be electrolytic concentration cells. "Adaptation, or the general change in sensitivity to radiation of all wave-lengths, is conditioned by a change in the *concentration* of the light-sensitive substances in the retina." The retinal selectivity, or relative brightness of any radiation, probably depends on two factors—rod sensitivity and cone sensitivity. The former was measured some time ago by von Kries and others, while the latter has recently been measured by Ives and again by Nutting. The "visibility curve" of Nutting and Ives represents the relative sensitiveness of the cones to luminous radiations of different wave-lengths but of equal energy. It has one maximum, which is in the green, and it sinks rather rapidly towards the red and the violet ends of the spectrum. The curve is almost symmetrical, and Troland finds that when it is corrected for the *selective transmission* of the ocular media, macula lutea, etc., it is almost perfectly symmetrical, and approximates closely to the simple probability function.

Both Troland and Houstoun (16) have used this curve as the basis for some general remarks on color-vision. The former argues, as in substance also the latter, that "this striking symmetry of the cone visibility curve leads almost inevitably to the inference that *luminosity is due to a single photochemical process in the retina* [*i. e.*, in the cones], and is not to be attributed to a summation of the response intensities of three or more color processes. . . . A more reasonable view lies in the original assumptions of Hering's theory, which identified luminosity with whiteness, and postulated a single, independent process for white, having a maximum in the middle of the spectrum." This view is further borne out by the fact that the following phenomena seem to be governed by intensity alone and not at all by wave-length:—the time required to produce a just-noticeable negative after-image, the time required for a stimulus to produce its maximum apparent brightness, critical flicker frequency, visual acuity, luminosity contrast and the summation of brightnesses (Ives).

Starting from the same visibility curve Houstoun (16) advances a "theory of color vision" which "does not depend on primary color sensations." "The most obvious explanation [of the curve] is to suppose that there exists in the eye a very great number of

vibrators, with a free period in the green, and that these execute forced vibrations under the influence of the light wave. The amplitude of the forced vibrations is a maximum when the free period of the vibrators coincides with the period of the incident light." These vibrators set up in the nerves waves which are transmitted to the brain. Trichromatism receives the following explanation: "The color-perceiving center [in the brain] is so badly developed that, so far as it is concerned, the curve [of the wave-lengths which reach the brain] is sufficiently specified by three points on it, provided that these points are distributed over the spectrum." The author does not "think it necessary to assume two different mechanisms," *i. e.*, rods and cones. "One system of vibrators will suffice." The word "assume" used in this connection illustrates how even to-day the physicist is apt to be ignorant of physiology, the psychologist of physics, and so forth. Von Kries (**25**) gives measurements of the relative amounts to which rods and cones participate in vision at various light-intensities: this is practically a correlation of the rod and the cone visibility curves previously mentioned. Under illuminations of the field varying from .01 to 25 candle meters, the proportionate part played by the rods in the seeing of gray paper ranges from .8 or .9 down to about .2. The intensity of illumination at which rods and cones participate equally varies, with different observers, from 1 to 5 candle meters. The computation involves an ingenious piece of reasoning.

There are two other papers of general scope. Ladd-Franklin (**26**), in a discussion of Parsons' book on "Color Vision," touches on several points of systematic interest, particularly trichromatism *vs.* tetrachromatism, and the relations between the Helmholtz, Hering, and Ladd-Franklin theories. And Goldschmidt (**15**), in a paper on "*Eigenlicht*," undertakes to summarize the various theories that have been advanced in explanation of the whole range of "subjective visual phenomena," and this interpreted so liberally as to include saturation, brightness, contrast, etc. These theories refer the phenomena to one or more of the seven possible sources named, which range from the dioptric apparatus to the Wundtian laws of apperception. The presentation is somewhat diffuse and academic.

Langfeld (**27**), in a paper which is perhaps on the border line between vision and thought-process, describes some experiments on imagery in which the subject was required to suppress some very

strong associations as for instance certain numbers in a consecutive running through of parts of the number series. The appearance and disappearance of imagery is significant. Imagery frequently "means" inhibition, and frequently it appears as a cue and the inhibitory process follows. Even very inadequate imagery can initiate and successfully guide motor response. After some practice of the *Aufgabe* imagery tended to disappear, but "when there was difficulty the image tended to appear again." Such observations, it seems to the reviewer, should be utilized in tracing the connection between immediate vision and the "higher processes."

From the introspective point of view Titchener and James Ward have argued as to the sensory character of black. In 1905 Ward expressed the opinion that black is not a "sensation"; that it is comparable to auditory silence. Titchener (31) finds that Ward does not distinguish nicely between the strictly introspective findings on "black," and such extraneous considerations as the conditions of eye stimulation and theories of vision. In his reply (41), Ward insists that black is not a "positive sensation; though a 'body-color,' *i. e.*, a secondary quality in the epistemological sense, we must allow it to be." Titchener (32) publishes a rejoinder. The arguments are somewhat finely-spun, by both sides. It all comes down, doubtless, to the question as to whether one *sees* black as a sensory quality, and here probably the great majority of persons would agree with Titchener. Alspach (2) studies, by three methods, the question of "simplicity *vs.* complexity of color hues," and concludes that "however 'like' a hue may be to neighboring hues, it apparently cannot be resolved by purely psychological methods into these hues as components." It would be a mistake to accept this conclusion without an examination of the tables presented. There were many judgments of "complex" and many of "unitary," and it does not appear to the reviewer why either type of judgment should be arbitrarily minimized.

Among other qualitative papers is one of unusual interest by Swindle (30), on positive after-images of long duration. "In successive and simultaneous color induction, any color induces first itself and last of all its antagonistic color." A second positive may succeed the latter, and the duration of one or more of these phases can be remarkably prolonged by inhibiting all muscular activity, and by very brief and carefully timed renewals of the stimulation. In this way the author has obtained positive after-images of hallucinatory intensity and several minutes' duration.

In one case a positive after-image was renewed in great distinctness after forty minutes spent in a well-illuminated room. This observation is somewhat like those of G. H. Miles (1915). Swindle suggests that such after-images are utilized by spiritualistic mediums. He further describes some experiments in which an owl and a cockatoo were observed trying to adjust themselves with reference to an after-image, *e. g.*, they tried to hop on to an after-image of the perch. It was evident that the after-image appeared to move with movements of the bird's head and body. These observations are in method novel, and admirably illustrate the behavioristic point of view.

Cook and Kunkel (7) report that the simultaneous and successive contrast color for red is bluer than the true complementary (color-mixture); and for yellow and blue is redder than the complementary. The "anomaly" is enhanced when brightness contrast is eliminated. Almack and Arps (1) have studied the effect of a preceding colored stimulation on the recognition limen for color. In general, if the after-effect of the preceding stimulation is similar to the second stimulus, the limen for the latter is thereby lowered. But an inducing stimulus of any color will to some extent lower the color limen for a succeeding stimulus, and this even when the after-effect of the former is of a color complementary to the latter. Troland (40) describes an interesting "reversal" effect. One half of a circular field is exposed for 30 seconds, and then the second half is exposed as well. The longer-exposed half of course appears the less bright. If 3 seconds later the intensity of the whole field is reduced to one tenth, and then after 45 seconds more is restored to its original intensity, the longer-exposed half will appear *brighter* than the half that has been less exposed. This seems to reverse the law of fatigue. The effect can be obtained under a considerable variety of conditions, and "is present most strongly in the long-wave end of the spectrum, and with decrease in the wave-length higher and higher intensities are required to bring it out." The same author (37) has repeated, with several additional and obviously necessary precautions, the experiment with which Hering (1915) claimed to have demonstrated the Purkinje phenomenon to be fleetingly obtainable in foveal vision. With the additional precautions it was found "impossible to detect the slightest trace of a Purkinje effect when [foveal] fixation was accurately maintained." Weiss (42) describes an interesting mat woven from strips of colored papers, which is designed for demon-

strating the Purkinje phenomenon. A small white spot is fixed in the centre; and in twilight vision this is not visible foveally, while the adjacent colored squares are less distinct than those that are seen peripherally. "The foveal area tends to be filled in by imagery of the surrounding surfaces" (like the blind-spot). At that intensity of illumination for which the colors of the squares become just visible, the mat appears "to be made of mosaics which seem to be at different distances" from the observer.

Of the more exactly quantitative papers, several deal with the flicker-photometer. Ives and Kingsbury (17) add a second instalment to their (1914) theory of the flicker-photometer, and in this discuss "unsymmetrical conditions," *i. e.*, unequal periods of light and dark stimulation. This theory (for which see the earlier paper) is important, and while the authors do not claim that it is as yet entirely satisfactory quantitatively, yet "it does handle the principal phenomena qualitatively in a very striking manner." The flicker-photometer may be used in two ways. In one of these the color to be measured is alternated with black, and the speed adjusted until flicker just disappears. The speed so found is a measure of the intensity of the color. This method is "very insensitive." According to the other way, which is "very sensitive," the color to be measured is alternated with a variable and measurable white. The latter is adjusted to approximate equality with the former, and the speed then found which will just not give complete fusion; this speed is now kept. The white light is now again and more carefully adjusted, until the minimum of flicker is obtained. The intensity of the white is now equal to, and a measure of, the intensity of the colored light. "The high sensibility of the flicker photometer is shown to be due to the very rapid increase in the critical frequency of disappearance of flicker on each side of the equality setting." When the compared lights are exposed "for unequal periods, the less exposed color will be under-rated. This form of flicker photometer is less sensitive than the ordinary equal exposure arrangement."

Troland (35) says: "The flicker-photometer frequency of any two visual stimuli may be defined as the rate of alternation (cycles per second, with equal intervals) of the two in the same photometric field, which is just sufficiently rapid to eliminate flicker, when the ratio of their intensities is such as to give a minimum of flicker at a slightly lower rate." Both Troland (33, 35) and Ives (22) find this critical frequency to increase with the hue difference between

the lights compared. Troland finds that the flicker frequency curve for a white standard compared with various spectral colors shows one minimum, at about 575$\mu\mu$, and maxima towards each end of the spectrum. "A considerable alteration of the color tone of the standard changes the position of the minimum only slightly, so that it seems very probable that the curve depends upon the *inherent saturation* of the spectral colors at equal luminosity. . . . The addition of a white light to a saturated spectral color decreases its flicker photometer frequency very slowly." Ives (**22**), from in part similar measurements, is led to a different conclusion. He finds the critical frequency to be intrinsically a direct function of the "number of hue steps" between the compared lights. "If the comparison lamp is red, the minimum speed is in the red, if blue, in the blue, if yellow-white, in the yellow, but with a much higher speed at the blue than at the red end, while for a true white (5000° black body) the curve is symmetrical about a minimum in the green." And Troland (**38**) finds that in heterochromatic comparisons of brightness which are not based on apparent equality, but on just-noticeable inequality of brightness between the two colors, "the brightness discrimination threshold is a minimum for a minimum of color difference between the two compared stimuli," and "on the average it has a value four or five times its minimum, for a maximum of color difference."

Troland (**39**) further reports the critical frequency to be a direct function of the intensity of the compared lights. "If the logarithms of the frequencies for any one color are plotted against the logarithms of the intensities, the resulting curve is approximately a straight line for intensities between 40 and 1560 photons." In the Ives-Kingsbury theory of the flicker-photometer Ives (**21**) points out that "there figure two fractions, the brightness discrimination fraction, and the hue discrimination fraction. . . . The ratio of hue fraction to brightness fraction is about ten times larger for intermittent than for steady vision. *Herein lies the reason for the success of the flicker photometer.*" Crittenden and Richtmyer (**8**) deem the flicker-photometer distinctly more reliable than the equality-of-brightness photometers, whether the color differences between the lights to be measured are great or small. In (**19**) and (**17**) Ives discusses another factor, "diffusivity," which figures importantly in the Ives-Kingsbury theory. This seems to be so far an element in the theoretical equation, rather than an actually identified physiological process. For a given speed of the flicker-

photometer, an abrupt transition between the two illuminations enhances the sensitivity. But with such a transition mechanical imperfections in the apparatus can introduce serious errors. For some purposes a gradual transition is preferable. Ives (20) describes a flicker-photometer in which by means of polarizing prisms the sharp dividing edge is eliminated: one phase disappears as the other simultaneously appears, both decrease and increase exactly following the sine function.

Ferree and Rand (9) describe a method of heterochromatic photometry in which the stimulus to be measured is viewed peripherally (25 degrees) while the other field is fixated directly. Johnson (23) points out several objections to the method as described, which seem to the reviewer to be well-founded.

Troland (33, p. 952) proposes the term *minuthesis* for the "depression of a sensation under the influence of a stimulus, to replace the misleading word, 'fatigue.'" In (34) he gives measurements of the time required to produce a just discernible minuthesis for different colors at the same intensity. He also gives measurements (34, 36) of the time required for the retina to reach a condition just indistinguishable from that of equilibrium. For, "given a sufficiently long exposure, the visual system reaches a *state of equilibrium* with respect to any stimulus which may be acting upon it." In this state the eye yields a sensation which is not subject to further minuthesis.

Cobb (4) reports on the effect on vision of brightness of surroundings. He finds that brightness discrimination, and to a less extent visual acuity, are reduced when the surroundings have a considerably higher brightness than that of the test-field. Bright surroundings, *if not brighter* than the object to be looked at, are probably better for the seeing of detail than are dark surroundings. Brightness discrimination is best when the surrounding field and the test-field are of the same brightness. Cobb (5) also describes an improved apparatus for the study of this and similar problems. Nutting (28, of which 29 is an abstract) gives compact data on: (1) threshold brightness for different degrees of brightness adaptation; (2) "the brightness that would just appear uncomfortably bright [glare] with the retina adapted to any given brightness"; (3) the limen of brightness difference for different degrees of brightness adaptation (*cf.* Cobb, 4). A new term, "discrimination factor," "is defined as the field brightness [general brightness adaptation] divided by the just noticeable difference, B/dB. This

quantity is a direct measure of the power to distinguish details except when large color differences are present. Visual acuity so called, a mere sharpness of definition, is a minor factor when contrasts are slight." A brief but comprehensive table of measurements of this factor (for field brightnesses varying from 0.0000001 to 10,000.0 millilamberts) is given.

Ferree and Rand (12) add a fifth contribution to their series dealing with conditions of lighting. A considerable number of tables is given, which deal mainly with the properties of pendent reflectors, and will be of interest chiefly to those who are studying the question of illumination. The authors have summarized their general results in (13) and (14) where, however, little is added to the substance of papers which were reviewed in the BULLETIN in 1916. The authors find that it is highly desirable to have the field of vision uniformly illuminated (*cf.* Cobb, 4, and Nutting, 28), the light well diffused, and no extremes of surface brightness. Caldwell (3) finds "for a given observer and a given value of illumination a rather definite preferred relation between direct and indirect illumination." This preference is for rather "more indirect than direct illumination." This is in general agreement with findings of Ferree and Rand. Also "a notable capacity for retaining a concept of an illumination value and of reconstructing it after an interval of time, is demonstrated."

Of papers dealing more especially with methods and apparatus, one of the most generally valuable is by Cobb (6). The paper is written for "investigators in those branches of biological science which deal with light-effects," and describes clearly some of the fundamental physical conceptions which must be understood by any one who wishes to manipulate light-stimuli intelligently. Some of the heads treated are: Point and extended sources, regular diffuse and mixed reflection, the three analogous types of transmission, reflectors and transmitters as secondary light-sources, images as visual objects, the measurement of brightness, and the relation of light to energy.

Ferree and Rand (10) describe an ingenious form of campimeter in which the stimulus is spectral light of known wave-length and intensity, and can be presented at any point (up to about 90 degrees of eccentricity) of any meridian of the retina. The same authors (11) suggest, as a substitute for the artificial pupil, focusing the stimulus light upon the pupil of the eye, there "forming an image of the analyzing slit of the spectroscope." The essential features

of this method have been previously described by Cobb (*Amer. J. of Physiol.*, 1911, **29**). Ives (**18**) describes an improved form of his visual acuity testing device (first described in 1910). The two single-line gratings of the earlier form are now replaced by cross-line gratings, which when rotated with respect to each other present a pattern of uniformly distributed squares which expand or contract as the gratings are turned. Kirschmann (**24**) recommends gelatine light-filters for the production of "monochromatic" light. The main advantage is that large areas can be illuminated. No special formulae for monochromatic gelatine dyes (the crux of the whole matter) are mentioned. Woodworth (**43**) gives an equation for calculating the conjugate foci of spherical lenses. The equation that is now commonly given in text-books is app roximately accurate only for very thin lenses.

References

1. Almack, N. & Arps, G. F. On Color Induction with Reference to Color Recognition. *J. of Exp. Psychol.*, 1916, **1**, 426–453.
2. Alspach, E. M. Simplicity vs. Complexity of Color Hues. *Amer. J. of Psychol.*, 1916, **27**, 273–282.
3. Caldwell, F. C. On the Effect of Brightness of Light Source on General Illumination. *Trans. of the Illum. Eng. Soc.*, 1916, **11**, 1042–1049.
4. Cobb, P. W. Vision and the Brightness of Surroundings. *Trans. of the Illum. Eng. Soc.*, 1916, **11**, 372–398.
5. Cobb, P. W. The Effect on Foveal Vision of Bright Surroundings—III. *J. of Exp. Psychol.*, 1916, **1**, 419–425.
6. Cobb, P. W. Photometric Considerations pertaining to Visual Stimuli. *Psychol. Rev.*, 1916, **23**, 71–88.
7. Cook, H. D. & Kunkel, F. M. The Qualitative Relation between Complementary and Contrast Colors. *Psychol. Monog.*, 1916, **22**, 1–39.
8. Crittenden, E. C. & Richtmyer, F. K. An "Average Eye" for Heterochromatic Photometry, and a Comparison of a Flicker and an Equality-of-Brightness Photometer. *Trans. of the Illum. Eng. Soc.*, 1916, **11**, 331–366.
9. Ferree, C. E. & Rand, G. A New Method of Heterochromatic Photometry. *J. of Exp. Psychol.*, 1916, **1**, 1–12.
10. Ferree, C. E. & Rand, G. A Spectroscopic Apparatus for the Investigation of the Color Sensitivity of the Retina, Central and Peripheral. *J. of Exp. Psychol.*, 1916, **1**, 247–283.
11. Ferree, C. E. & Rand, G. A Substitute for an Artificial Pupil. *Psychol. Rev.*, 1916, **23**, 380–382.
12. Ferree, C. E. & Rand, G. Some Experiments on the Eye with Pendant Reflectors of Different Densities. *Trans. of the Illum. Eng. Soc.*, 1916, **11**, 1111–1136.
13. Ferree, C. E. & Rand, G. A Résumé of Experiments on the Effect of Different Conditions of Lighting on the Eye. *Ann. of Ophth.*, 1916.
14. Ferree, C. E. & Rand, G. Miscellaneous Experiments on the Efficiency of the Eye Under Different Conditions of Lighting. *Ophthalmology*, 1916, **12**.

15. Goldschmidt, R. H. Die Frage nach dem Wesen des Eigenlichtes, ein Hauptproblem der psychologischen Optik. *Psychol. Stud.*, 1916, **10**, 101–155.
16. Houstoun, R. A. A Theory of Colour Vision. *Proc. of the Roy. Soc.*, 1916, A, **92**, 424–432.
17. Ives, H. E. & Kingsbury, E. F. The Theory of the Flicker Photometer.—II. Unsymmetrical Conditions. *Phil. Mag.*, 1916, **31**, 290–321.
18. Ives, H. E. An Improved Visual Acuity Test Object. *J. of the Franklin Inst.*, 1916, **182**, 539.
19. Ives, H. E. Visual Diffusivity. *J. of the Franklin Inst.*, 1916, **182**, 540–541.
20. Ives, H. E. A Polarization Flicker Photometer. *J. of the Franklin Inst.*, 1916, **182**, 541–542.
21. Ives, H. E. Measurements of Brightness-Difference Perception and Hue-Difference Perception by Steady and Intermittent Vision. *J. of the Franklin Inst.*, 1916, **182**, 542.
22. Ives, H. E. Hue Difference and Flicker Photometer Speed. *J. of the Franklin Inst.*, 1916, **182**, 812.
23. Johnson, H. M. A Note on Ferree and Rand's Method of Photometry. *Psychol. Rev.*, 1916, **23**, 390–396.
24. Kirschmann, A. Ueber die Herstellung monochromatischen Lichtes in grösseren Flächen. *Psychol. Stud.*, 1916, **10**, 185–188.
25. Kries, J. von. Messende Versuche über die Funktionsstellung im Sehorgan. *Zsch. f. Sinnesphysiol.*, 1916, **49**, 297–315.
26. Ladd-Franklin, C. On Color Theories and Chromatic Sensations. *Psychol. Rev.*, 1916, **23**, 238–249.
27. Langfeld, H. S. Concerning the Image. *Psychol. Rev.*, 1916, **23**, 180–189.
28. Nutting, P. G. Effects of Brightness and Contrast in Vision. *Trans. of the Illum. Eng. Soc.*, 1916, **11**, 939–946.
29. Nutting, P. G. The Effects of Brightness on Vision. *J. of the Franklin Inst.*, 1916, **182**, 531–532.
30. Swindle, P. F. Positive After-Images of Long Duration. *Amer. J. of Psychol.*, 1916, **27**, 324–334.
31. Titchener, E. B. A Note on the Sensory Character of Black. *J. of Phil., Psychol., &c.*, 1916, **13**, 113–121.
32. Titchener, E. B. A Further Word on Black. *J. of Phil., Psychol., &c.*, 1916, **13**, 649–655.
33. Troland, L. T. Apparent Brightness; Its Conditions and Properties. *Trans. of the Illum. Eng. Soc.*, 1916, **11**, 947–966.
34. Troland, L. T. The Laws of Visual Minuthesis: the Threshold Preëxposure Time and the Equilibrium Time for a Projected Negative After-Image. *J. of the Franklin Inst.*, 1916, **181**, 579–581.
35. Troland, L. T. Notes on Flicker Photometry: Flicker-Photometer Frequency as a Function of the Color of the Standard, and of the Measured Light. *J. of the Franklin Inst.*, 1916, **181**, 853–855.
36. Troland, L. T. The Laws of Visual Minuthesis: the Influence of Intensity on the Equality Time-Function. *J. of the Franklin Inst.*, 1916, **181**, 855–856.
37. Troland, L. T. The Absence of the Purkinje Phenomenon on the Fovea. *J. of the Franklin Inst.*, 1916, **182**, 111–112.
38. Troland, L. T. The Heterochromatic Brightness Discrimination Threshold. *J. of the Franklin Inst.*, 1916, **182**, 113–115.

39. Troland, L. T. Notes on Flicker Photometry: Flicker-Photometer Frequency as a Function of Light Intensity. *J. of the Franklin Inst.*, 1916, 182, 261–263.
40. Troland, L. T. The Revival of a Faded Negative After-Image by Brightening the Stimulus Field. *J. of the Franklin Inst.*, 1916, 182, 529–530.
41. Ward, J. A Further Note on the Sensory Character of Black. *Brit. J. of Psychol.*, 1915, 8, 212–221.
42. Weiss, A. P. Purkinje Demonstration. *Psychol. Bull.*, 1916, 13, 442–444.
43. Woodworth, C. W. A New Fundamental Equation in Optics. *Science*, 1916, 43, 824–825.

CUTANEOUS AND KINÆSTHETIC SENSES

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Although the war has greatly reduced the number of articles on cutaneous and kinæsthetic senses, still the literature of the past year in some ways makes up in intensive interest what it lacks in extensity. Most important is the continued interest in the line of work started by Head and his collaborators. The study of the cutaneous sensibility of skin areas supplied by regenerating nerves was continued by Trotter and Davies, and with somewhat different technique by Hacker whose results were reported last year.[1] During the past year Boring (2) has published the results of his experiment on nerve-division. He has added to the results a critical review of Head's theory and a theoretical proposal of his own. Moreover, Carr (3) has made a painstaking examination of Head's results in connection with a critique of the Head theory. Boring's work was undertaken under rigidly controlled psychological conditions, the author himself acting as subject. The investigation therefore had the advantage of having a trained psychologist as observer. Quantitative methods were employed to test the sensitivity of the affected area. There was also a preliminary period of practice. This covered fifteen months before the operation during which time the subject devoted from three to eight hours a week to practice in discrimination of different cutaneous sense qualities, localization, and discrimination of two points. The nerve chosen for section was the anterior branch of the internal cutaneous of the left arm. As a result of the operation a small area of skin on the left forearm became anæsthetic. This area was located near the wrist on the volar surface and slightly to the

[1] See this Bulletin, 1916, 13, 138.

ulnar side. This area consisted of two zones, a central one of cutaneous anæsthesia, and surrounding this a zone in which hypoæsthesia prevailed, this condition increasing in degree from the outer edge to the inner boundary. The regions of sensory loss were approximately the same for the different forms of sensibility, although their distribution over the skin was always irregular and patchy. The outer parts of the affected area regained their sensibility first, and there was no evidence that recovery followed the course of the nerve. Deep sensibility to pressure and pain was not changed at any time during the course of the experiment. The four cutaneous sense qualities tended to return from anæsthesia or hypoæsthesia through diminishing degrees of hypoæsthesia to normal. Warmth and cold, however, passed through an intermediate stage of hyperæsthesia. Pain, pressure, and cold all returned to normal at about the same rate; warmth returned much more slowly. In the course of recovery warmth and cold sensations were often remotely referred. Sometimes a sensation was felt as "double," remote reference and immediate reference occurring together. In the experiments on localization and two-point discrimination pressures of 20 gm. were used, and it was found that these functions were unaffected. No new qualities of sensation were experienced at any time. Many unique experiences were found to be merely unusual combinations of familiar qualities. The author's objections to the Head theory are that it is not borne out by analogy in the other sense spheres, that it fails to account for many established facts of cutaneous sensibility, that it does not even explain the facts it attempts to summarize, and finally that it indicates a number of doubtful generalities. The author proposes another theory which he summarizes as "one which assumes that single sensory spots are innervated by more than one nerve fibre, that the multiple innervation is projected upon the central nervous system as multiple excitations which depend for their degree upon their relative strengths, their separations in the region of projection, and a limitation of the available amount of central energy. Under these conditions, multiple innervation may be effective as summation or as inhibition of the excitations involved. The division of inhibiting fibers may result in hyperæsthesia or in abnormal localization; the gradual appearance of these forms of abnormality is due to the gradual effect of practice in the assumption of vicarious function." For the consideration of the results in the light of this theory as well as for an appreciation

of the many niceties of method and the numerous particular results, reference must be made to the original article.

Carr (3), in criticizing Head's theory, calls attention to the fact that it requires, as Head rightly admits, that: (1) The various qualities must fall into two independently variable groups; either group may be present while the other is absent, and (2) within the group all functions must invariably occur together; no internal dissociation is possible. The author's first criticism is one of fact. A careful analysis of Head's data seems to him to show that neither of the two requirements is met. The author tabulates this data and he thinks that if a number of persons without knowledge of Head's theory should be confronted with the table they would conclude in favor of six or seven variables instead of Head's two. The second criticism has to do with Head's assumption that the time of recovery for the "protopathic" system is a constant irrespective of the location of the nerve-section. The figures, however, indicate that recovery proceeds from the end of the affected area near the point of section to the further end, and this order holds for both systems. The third criticism is concerned with the application of the theory to explain the peculiar sensitivity of certain areas. A consideration of the forms of cutaneous sensibility which exist in these areas seems to indicate that the qualities of either of Head's two systems may be dissociated and exist apart from each other. The author raises the question of whether Head's seven qualities can be reduced to the conventional four, and he believes that they can by regarding the "protopathic" qualities as a natural result of an early stage of recovery, at which time the stimulus threshold would naturally be high.

Ranson and Billingsley (9) in a physiological study of the conduction of painful afferent impulses, bring their results into relation with Head's theory. Experimenting upon cats, they find that the afferent impulses which give rise to pain reactions are conducted over the lateral division of the dorsal roots. The fibers in this division, in contrast to those in the medial division of the dorsal root, are unmyelinated. These fibers, the authors think, present great similarities to what is known of Head's "protopathic" fibers, and, mediating as they do the quality of pain, they think it likely that they mediate the other "protopathic" qualities of cold and warmth as well.

Dimmick (5) reports a study of cutaneous after-images. Previous investigators had found a difficulty in such work in that there

seemed to be two after-sensations, each one regarded as coming from a separate source. In this investigation therefore care was taken to use stimuli known to be above the limen for sub-cutaneous pressure. After the removal of the stimulus the sensation was followed by an after-sensation, this was followed by a latent interval, and this in turn by an after-image. The duration of these three processes is measured for each of the two subjects who took part in the experiment. Although the absolute duration is a number of times longer for one subject than for the other, the relative times for the three intervals are approximately the same for both. The after-sensation is about twice as long as the latent interval, and the after-image about four times as long as the after-sensation.

Amantea (1), writing from the war zone, describes an æsthesiometer constructed from materials available in a field hospital. He has found it serviceable in the field, but it is doubtful if it represents a valuable contribution to laboratory apparatus.

As far as the reviewer knows, no experimental investigation of kinæsthetic sensations as such has appeared during the past year. Several articles have appeared, however, which should be of interest in this connection. In connection with a discussion of the importance of movement to the organism Dearborn (4) lays emphasis upon the rôle of kinæsthesia in consciousness. Kinæsthesia plays a large part in "cenesthesia" which is "the ground-work of the mind, conscious and sub-conscious." Physiological studies of the effects of labyrinth extirpation in the cat are reported by Prince (8), and by Muller and Weed (7) and Fisher and Muller (6). One of the immediate results of unilateral extirpation of the labyrinth is torsion of the head to the injured side. Finding that in the cat this posture is associated with diminished tonus in the cervical musculature on the side of the lesion, Prince tried various combined lesions of labyrinth and dorsal roots of the cervical nerves to see how the torsion would be affected. The results of different combinations seem to indicate that the torsion after unilateral removal of the labyrinth is due to the preponderating activity of the muscles on the intact side. The other study of labyrinth extirpation was undertaken first to investigate the falling reflex of the cat. Experiments with normal cats showed that when held upside down and dropped they could accomplish the 180 degrees turn necessary to light on their feet in a fall of a foot, and some were able to do it in six inches. When one labyrinth was extirpated the cats could still accomplish the turn in the air, but they always turned away

from the affected side even when held so that they would have to turn through 270 degrees to do it. The study of cats with unilaterally extirpated labyrinths was continued by extending the observation over a considerable period of time. When blind-folded and dropped these cats turned, always away from the operated side, but they did not necessarily land on their feet as they kept on turning until they struck the bed of straw upon which they were dropped. One, when dropped from a considerable height, was observed to make two complete turns in the air. This turning on the part of the blind-folded unilateral cats could not be accomplished until twenty-four hours had elapsed after the operation. Some of the unilateral cats were placed in water. They started to swim, but immediately the side toward the lesion went down, submerging their heads and depriving them of the use of their eyes, and then they began to revolve continuously and rapidly about their long axis in the direction away from the lesion. The nystagmus which immediately followed unilateral extirpation disappeared about thirty hours after the operation. In the course of a few days the tendency to walk in a circle was lost, and there was a gradual though incomplete recovery of the normal postural and muscular reactions of the animal. After two months two of the cats were able to swim as long as they kept their heads above water, though the instant their heads went under they began to revolve.

References

1. Amantea, G. Un estesiometro semplice e pratico. *Riv. di psicol.*, 1916, 12, 293–295.
2. Boring, E. G. Cutaneous Sensation After Nerve-division. *Quart. J. of Exper. Physiol.*, 1916, 10, 1–95.
3. Carr, H. Head's Theory of Cutaneous Sensitivity. *Psychol. Rev.*, 1916, 23, 262–278.
4. Dearborn, G. V. N. Movement, Cenesthesia, and the Mind. *Psychol. Rev.*, 1916, 23, 190–207.
5. Dimmick, F. L. On Cutaneous After-images. *Amer. J. of Psychol.*, 1916, 27, 566–569.
6. Fisher, H. G. & Muller, H. R. Unilateral Destruction of the Semicircular Canals in Cats. *Amer. J. of Physiol.*, 1916, 41, 267–274.
7. Muller, H. R. & Weed, L. H. Notes on the Falling Reflex of Cats. *Amer. J. of Physiol.*, 1916, 40, 373–379.
8. Prince, A. L. The Position of the Head after Experimental Removal of the Otic Labyrinth. *Proc. Soc. for Exper. Biol. & Med.*, 1916, 13, 156–159.
9. Ranson, S. W. & Billingsley, P. R. The Conduction of Painful Afferent Impulses in the Spinal Nerves. *Amer. J. of Physiol.*, 1916, 40, 571–584.

ORGANIC SENSATION

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Boring (1) has found that stimulation of the esophagus may give rise to qualities of warmth, cold, heat, and thermal pain, which are identical psychologically with the corresponding qualities from the skin; that cutaneous pressure and pain can not be elicited from the esophagus, but that distension brings out successively the qualities of muscular pressure and muscular pain. The esophageal sensations are referred away from the middle portion of the esophagus in the direction of one end or the other.

Carlson has brought together in a book the numerous researches by himself and his collaborators on the physiology of the stomach. This book, *The Control of Hunger in Health and Disease* (4), summarizes the work in its field and includes a useful, if inaccurate, bibliography of 283 titles. Carlson demonstrates conclusively that the gastric mucosa is insensitive to tactual and painful stimuli of all sorts. He had an exceptional opportunity for experimentation upon his subject with the gastric fistula, since he could get at the mucosa directly. The sense of fulness, which comes with distension of the stomach, and the pain found by Boring and others with great distension must come from the muscular coats.

Carlson also finds the gastric mucosa to be endowed with "protopathic temperature sensibility," since hot and cold water and ice are effective stimuli. Boring inclined in his first paper (1) to the belief that the stomach was thermally insensitive, because such extreme temperatures were needed to bring out the two thermal qualities. Later (3) Boring measured the temperature within the stomach by means of a thermo-electric couple and found that extreme stimuli, as determined before their mixture with the stomachic contents, are very much nearer body-temperature when they become effective in the stomach, and that such mild temperatures as 30° and 40° C. produce in the gastric mucosa the sensations of cold and warmth respectively. Obviously Carlson's use of Head's term "protopathic" is unfortunate in this case, for here we have, in a region which is theoretically protopathic, thermal sensations with epicritic thresholds, dissociated from the epicritic *sine qua non* of pressure and the protopathic *sine qua non* of pain. Both Carlson and Boring agree that the thermal sensations of the stomach and

of the esophagus are introspectively separable with respect both to pattern and to localization.

Carlson's work appears to establish finally the correlation of sensation of hunger with the hunger contractions of the stomach; hence the conditions of the hunger contractions gain psychological significance as the conditions of hunger. Thus hunger appears to diminish with advancing age, to be decreased by smoking and, in its initial stages, by tightening the belt, and to be inhibited by stimulation of the mouth (even chewing paraffin may be effective) and of the gastric mucosa, and by dreaming (6). Physical exercise, external cold, excessive hemorrhage, and, in spite of the current belief to the contrary, starvation, all increase hunger. Qualitatively—both Carlson and Boring (2) agree—hunger is a complex of muscular pain and kinesthetic pressure.

Boring (2) finds that thirst, nausea, defecation, urination, and the calls to defecation and urination are also complexes of pain and pressure, without qualitative novelty. Thirst is referred more to the mouth than to the throat. Nausea appears in many different patterns but always with a core of pain that is similar to or identical with the hunger pain. Carlson admits the presence of tension and pain in nausea, but urges that over and above these concomitants there is a "distinct 'sickness' character" in nausea, and that a confusion of hunger and nausea is not normal.

Carlson's most positive psychological contribution is to the problem of appetite. He holds that the gastric mucosa is endowed with a "protopathic appetite sense." Far from being allied to hunger, the appetite sensation contrasts with the hunger sensation and is best perceived if weak chemicals (beer, wine, 0.5 per cent. HCl, gastric juice, cold water) are introduced into the stomach through a stomach-tube during hunger. The tube eliminates the sight, taste, smell, and imagery of the food, and the consequent salivation and movements of deglutition. The stimulus inhibits the hunger contractions and brings out the experience of appetite which contrasts with the preceding hunger. Appetite is not due to the cessation of the hunger since it can be brought out alone. The indication of a unique quality is strong, but it must be remembered that Carlson does not mean by sensation a psychologically simple quality, for he also speaks of hunger, a complex of pressure and pain, as a "sensation."

Cannon's book, *Bodily Changes in Pain, Hunger, Fear and Rage* (5), bears on the problem of organic sensation. His thesis is that

in certain sthenic emotions mentioned in his title the bodily state is the same, viz., the widespread effects that come from the excitation of the sympathetic nervous system and the secretion of adrenalin; and that these emotions are therefore not to be distinguished by their organic constituents. Cannon's description of this widespread action of the sympathetic system suggests that there must be a corresponding consciousness which forms a fixed emotive organic pattern and which, it seems to the reviewer, may ordinarily escape analysis into constituent organic sensations because of its very complexity.

REFERENCES

1. BORING, E. G. The Sensations of the Alimentary Canal. *Amer. J. of Psychol.*, 1915, **26**, 1–57.
2. BORING, E. G. Processes Referred to the Alimentary and Urinary Tracts: A Qualitative Analysis. *Psychol. Rev.*, 1915, **22**, 306–331.
3. BORING, E. G. The Thermal Sensitivity of the Stomach. *Amer. J. of Psychol.*, 1915, **26**, 485–494.
4. CARLSON, A. J. *The Control of Hunger in Health and Disease.* Chicago: Univ. of Chicago Press, 1916. Pp. 319. (This book is based upon a series of researches by the author and his collaborators appearing in *Amer. J. of Physiol.*, Vols. **33** to **39**. The titles, too numerous for separate citation here and many of them of but slight psychological bearing, are given in the bibliography of the book.)
5. CANNON, W. B. *Bodily Changes in Pain, Hunger, Fear, and Rage.* New York: Appleton, 1915. Pp. 311.
6. LUCKHARDT, A. B. The Effect of Dreaming on the Gastric Hunger Contractions. *Amer. J. of Physiol.*, 1916, **39**, 330–334.

SPECIAL REVIEWS

The Fundamentals of Psychology. W. B. PILLSBURY. New York: Macmillan, 1916. Pp. ix + 562.

Professor Pillsbury's new textbook "is intended to fill a gap which exists to-day between the smaller texts and the reference hand-books," as it is intended for students without previous training who are willing to give a year to the study of psychology. The first chapter treats of the general problems of psychology and with the general materials with which the science is interested. "It (psychology) deals with the activities commonly known as mental, the processes of perceiving, of remembering, of thinking, and particularly with the acts of the individual" (p. 1). Observation and introspection are the two general methods for attacking the problems of the science; but, of these, introspection is made a

supplementary method to the objective means of obtaining the facts.

Two chapters follow with a discussion of the structure and function of the nervous system. This structural discussion is largely from the histological viewpoint with a considerable section on the development of the nervous system. These chapters are plentifully illustrated with excellent cuts and diagrams. Next follow two chapters on sensation, one entire chapter being given to a discussion of vision, and the other to the sensations of all other modalities. The structure of the receiving end-organs, the facts of sensation and the principal theories are discussed. The attribute of quality is emphasized throughout and, indeed, quality and intensity are the only two admitted attributes of sensation, as all of the other alleged attributes are referred to perceptions.

There next appears a chapter on images, or, to use Pillsbury's terminology, "centrally aroused sensations." The laws of association and imaginal types are treated at this place. Attention and selection are discussed in the next chapter. The physiological accompaniments of attention and the conditions of attention are rather more strongly emphasized in this connection than are the psychological facts of the subject. Then follow two chapters on perception; the first on the perception of space; the second on the perception of visual movement, time and rhythm. The processes connected with reading and with the understanding of spoken language are discussed under the heading of the General Laws of Perception, and the importance of meaning is emphasized in this connection. Memory is next treated largely from the quantitative aspect. The discussion includes the factors of learning, such as the effect of repetitions and the like, and the rate of forgetting. The process of recognizing is placed under the general heading of remembering as is also that of productive imagination.

Next follows a largely speculative and logical chapter on reasoning. The term reasoning, as the author employs it, includes practically all of the so-called higher mental processes except recognition and will; namely, the incentives to reason, judgment, inference, belief, and proof. The importance of meaning is again discussed and emphasized at this point. The author's concept of instinct, which is next considered, is exceedingly broad and includes all sorts of reactions from a mere complex reflex, such as the chick pecking its way out of the shell, to the very complex reactions of man. Even "acquisitiveness, combativeness and sympathy"

are regarded as individual instincts. Racial and social instincts and the origin of instincts are also discussed.

A distinction is made in the next chapter between feeling and affection. The latter is considered to be a mental element and has only two qualities, pleasantness and unpleasantness. Feeling is conceived as a combination of this element and sensations. Emotion, which is next discussed, is conceived as a complex feeling plus the fact that it is accompanied by a purposive response. A modified formulation of the James-Lange theory of emotion seems to be accepted. After a discussion of the recent refined physiological work on the emotions, the author believes that the distinguishing marks between the different emotions are to be found in differences in facial expression and general bodily posture rather than in the finer and less obvious internal processes of secretion and the like. Professor Pillsbury (p. 480) turns from the shortcomings of the scientists to the novelists for confirmation of this view.

Volition is approached, in the next chapter, from the standpoint of the general principles of action. The trial and error methods of learning in man and animals are first discussed and the general form of the learning curves pointed out. The author stresses the incentives to movement and thus leads up to volition. The will process consists merely in a choice of incentives and, as soon as any particular incentive has been clearly attended to, it becomes a goal idea and the movement takes place. The control of movements and the factors leading to the choice of some particular motive for movement are discussed.

Professor Pillsbury, in the final chapter, treats of the self concept, again largely in a speculative and logical fashion. In the first place, he minimizes the importance of an awareness of self, this awareness becoming conscious only in times of struggle. The self consciousness is made up of a complex of three individual self concepts: (1) the bodily self, present largely in imagery of the body; (2) the subjective self, present in kinæsthetic and organic sensations; and (3) the effective or dynamic self, present in a "feeling of effort" which may be reduced structurally to sensations of strain.

The critic may question the pedagogical advisability of devoting nearly the first sixth of the space to a discussion of the anatomical and physiological basis for psychology, before the student has heard anything of or developed an interest in the science itself. This criticism would hold against the majority of the elementary textbooks, but Professor Pillsbury justifies his use of so much space

in the text by applying a physiological explanation to all of his processes; meaning, the self, dissociation, habit and association are all explained in physiological terms. We rather question the factual basis of some of these physiological explanations, however. Changes of resistance at the synapse are emphasized in many places. "All learning, whether in the formation of habits or in the connection of sensory impressions in sensory learning, is due to this reduced resistance." Meaning is explained in terms of "partially opened association paths" (p. 394). These are matters upon which the physiologists themselves are not agreed, as some very notable physiologists would still deny the significance of the synapse. It seems to us a rather mischievous proceeding to supply gaps in the body of psychological fact by explanations in terms of physiological theory which is not universally accepted.

We are particularly struck, however, by many inadequacies in the text. The kinæsthetic sensations are dismissed with a discussion of little more than two pages, although the author has defined psychology in terms of a modified behaviorism. Again, the question of imaginal types is given a discussion of three pages in one chapter and the importance of the different types to memory is given one page. We would also class among inadequacies of the text certain cases which we believe are cases of exceedingly false emphasis. For example, ten pages are given to the development of the nervous system while a total of only five pages is given to a discussion of complementary colors, color blindness, peripheral vision, negative after-images and visual contrast.

At the end of each chapter the author cites a list of references to general discussions of the subject matter covered; there seems to be, however, an inadequacy of exact references throughout the book. The date of publication is not added to any reference, which we believe is an unfortunate omission. At times certain references are given in footnotes to some particular experimental study. These are very few in number and at times unfortunately chosen, if any such references are to be given at all. For example, the only exact reference to any particular study in the entire chapter on vision—other than giving the names of authors in the text—is to an experiment by a Miss Bills. It turns out that her results were included in a footnote in an article by Ferree and Rand and this reference to a footnote is the only exact reference given in the entire discussion of visual sensations. We believe that the student who is to give a year to his study of psychology will desire more

frequent exact references to the literature than these, if he develops any interest at all in the science.

Professor Pillsbury mentions in his introduction that he will have little to say about methods, and he consistently adheres to this throughout the text. Such an attitude may be admissible in a superficial course in psychology but, we believe, that if the student is willing to give a year to the work he should obtain more than a mere accumulation of psychological facts. Besides these, he should obtain some concept of how these facts have been obtained so that he may approach his reading in a critical manner.

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Manual of Mental and Physical Tests. G. M. WHIPPLE. Baltimore: Warwick and York, 1915. Pp. v + 336. $2.00.

In the five years which elapsed between the first and the second edition of this work it firmly established itself as a manual of directions and as a compendium of the published results of 54 representative mental and physical tests. It serves as the standard reference book to which one who is to make tests naturally turns to consult before determining upon his method, and to get a starting point for a study of the literature.

The new edition, as was pointed out in the review in this journal of the first volume, is a thorough revision of the first edition, but is not at all altered in character. In this second volume, which deals with the complex mental processes, two new tests have been added—the Kent-Rosanoff test and the analogies test—and the Binet scale and other test series have been reserved for separate treatment. The immense amount of literature which has appeared on serial tests in recent years, and the peculiar principles which are involved in them, makes this procedure wise.

A notion of the amount of additional material which has been added in this volume may be gained from a few statistics. The number of pages has been increased from 185 (excluding the serial tests) to 315. All but 23 pages, which are occupied by the two new tests, represents new experimental work, most of which has been carried on since 1910. The number of references which are given for the same tests is more than doubled, increasing from 190 to 390.

The inclusion of this large amount of new material has necessitated complete revision. In some cases the directions or inter-

pretation of results have been modified independently of the requirements of the new material, but frequently recent work has caused elaboration of method, and still more frequently, the enlargement of the treatment of results.

Critical comment is hardly necessary. The work is carefully done and of very material service.

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Experimental Psychology. (A Loose Leaf Manual.) A. T. POFFENBERGER, JR. New York: Morningside Press, 1916.

A thoroughly up-to-date method of presenting experiments to be performed by a beginning laboratory class, is the Loose Leaf Method. Forty-eight experiments, each on a separate sheet, are available for immediate inclusion in the student's note book without the necessity of copying. At the direction of the instructor, certain experiments can be omitted or the order changed. Each experiment is headed with references to literature, among which, papers in the *Archives of Psychology* appear frequently. Credit is given also to Whipple's *Manual*, Titchener, Seashore, Sanford, Myers and Thorndike. There follow a statement of the problem, description of materials required and directions for the conduct of the experiment and tabulation of results. Under conclusions appear questions to be answered by the student, with suggestions for varying the procedure.

Among the experiments, novel to such a manual, is one entitled "Memory for Names and Faces." Photographs furnish the faces, the name to be associated is spoken by the experimenter at the time of showing. After 20 have been shown, they are again presented and the observer is directed to recall the name. The student's attention is called to memory, attention and emotions for an explanation of his failures. In a later experiment, photographs are to be classified according to the predominance of "intelligence, kindness, generosity, humor, neatness and honesty." Another series of photographs shows one person exhibiting 24 different facial expressions. In this experiment the task is to identify the emotion depicted.

No experiments leading to theories of color vision, audition, tactual sensations, etc., appear in the list. Instead, the first half of the list of experiments deals with learning, memory, association, imagery, and reaction time. The principles of action and function

are emphasized throughout. Practice effects, interference and inhibition, transfer, forgetting, recall and recognition lead on to the main conditions of memorizing, such as number and time of repetitions, material, position in the series, mass and sectional methods, and incidental memory. These topics are followed by a study of free and controlled associations, and the structure and function of imagery. The latter half of the list deals with spacial and temporal phenomena, the spectroscope and pseudoscope, size, direction, distance, localization, with discriminations and judgments, and closes with two experiments on fatigue.

The experimental directions are clearly written, and the choice of experiments leads to the problems of more general interest in psychology, eliminating many of those which are perhaps better suited for training in analytical research.

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The Intelligence of the Feeble-minded. BINET & SIMON. (Trans. by E. S. Kite.) Vineland, N. J.: The Training School, 1916. Pp. 321.

Among the lesser of the things they manage better in France is the expression of scientific observations in simple words; and a special service has been done in preserving that virtue to us in this compiling of translations from Binet. While it retains the French "accent," it has also kept the charm of the original's style. A translator who dares not depart far from the text seems to fare better with French than with German, which is clumsy in over-literal rendering, while the slight impress of Gallic affectation is far from unpleasing.

A move in French naval tactics has been described "to give the appearance of a weakness which does not exist." One wonders how often French scholarship makes a similar showing without the strategic sanction—as in this book. It would get short shrift from a critic trained to a statistical attitude towards mental phenomena. The book itself has little evidence that the authors' observations extended beyond the handful of cases of whom they tell us in a chatty, anecdotal way. But as Goddard brings out in his introduction, the subsequent confirming of the essential theses should convince us that when it is said that Denise or Cabussel do so and so, it is because Denise and Cabussel are also the symbols of large experience and brilliant intuition.

The measurement of intelligence has developed much since the appearance of these writings, and the well-posted reader must not expect many new suggestions on these points. It is rather as a keen analyst of mental processes that these chapters will preserve their leading author's name. His formulation of the attention problem, his discussion of the cooperative effort demanded by different tests, his division of the mental processes of speech, will repay the attention of others than those interested in defect conditions. In regard to false judgment (*esprit faux*) his interpretations run curiously parallel to those based by Janet upon a different material. Behaviorism may derive sanctions more agreeable than necessary from some lines in page 53, whose author was fully mindful of the diverging paths of the "purposive" psychologist and the psychophysicist.

He called attention to the "scattering" phenomenon in mental tests, and regarded it as more marked in psychotic than in defect conditions. Language ability he found relatively superior in the defective, as it seems also to be in the psychotic. He often assigns a more general significance to the intelligence scale than is done now, though he freely compares it to a "rod" with which only one dimension of mind is measured. Motor suggestions seemed to him to "encroach less upon the personality" than sensory ones (hallucinations).

Amid the flowering of his work on feeble-mindedness, Binet's observations of mental disease have had little notice. It will pay the reader whose interests lie here, to follow up his generalization that "senile dementia tends towards destruction of the ideational life, with conservation of the instinctive part of the thought." The mental losses of organic psychoses he formulated in large part as a failure of ideas to become conscious and thus make themselves effective in action, though they are nevertheless present; a failure of *evocation*, it is called. The woman who after many fruitless attempts was finally got to count backwards from 20 to 1, "knew very well . . . since she finally succeeded; it is not therefore, the knowledge that is lacking but the comprehension of what is asked of her." The essential difference between the mind of the imbecile and that of the organic psychosis is that of insufficiently differentiated states of consciousness on the one hand, and weakness in evocation of more complex states on the other.

It is a pity that there is no carrying out here of the fruitful comparison between these organic failures of "evocation," and those

which contemporary psychopathology inclines to attribute to psychogenic suppressions.

F. L. WELLS

McLEAN HOSPITAL

The Long Road of Woman's Memory. JANE ADDAMS. New York: Macmillan, 1916. Pp. xv + 168.

Miss Addams has written a book on several unrelated aspects of woman's experience and believes that in "Memory" she has found the unifying principle of them all. The fact that she fails in this does not detract from the value or interest of the book. The reader will find a presentation of Miss Addams's views on war, organized labor and other social problems, and an extremely interesting case of social suggestion which came under her observation for a long period of time, the rumor having spread that there was a "Devil Baby" at the Hull-House. If the psychologist can forget his business for the time being and adopt a non-professional attitude toward the book, he will find it interesting and instructive.

CARL C. BRIGHAM

PRINCETON UNIVERSITY

Love: A Treatise on the Science of Sex-Attraction. (2d ed.) B. S. TALMEY. New York: Practitioners' Publishing Co., 1916. Pp. x + 438.

Love is a text-book on the embryology, anatomy and physiology of the sex organs, and the pathology, psychology, hygiene and ethics of the sex-relationship. In treating these various aspects of sex Dr. Talmey has undertaken a comprehensive task, and has handled some parts of this task with comprehension.

The discussion of the psychology of sex is perhaps refreshing in that the author does not adopt the extravagances of the followers of Freud, but it is hardly illuminating. Dr. Talmey apparently has rather peculiar notions concerning the localization of function, for we find that the cerebellum is the seat of the sensations of touch, sight, smell and hearing, while the cerebrum is the seat of the "higher sensations," affection, admiration, worship and respect. We also learn that "all venereal troubles seem to exert an inhibitory influence upon the truth centers" (p. 177). The terminology is inexact and difficult to interpret. Among the "secondary mental characters" in man we find "manly will" and "manly grace." A novel eye condition is perhaps indicated by the description of

"the pupils in a state of hallucination." A long index is furnished for the convenience of the reader, and a bibliography is supplied which omits some of the references which are also omitted in the text.

CARL C. BRIGHAM
PRINCETON UNIVERSITY

DISCUSSION

CONCERNING THE NUMBER OF OBSERVATIONS NECESSARY FOR THE DETERMINATION OF A LIMEN

Some time ago[1] we reported the results of an experimental study of the effects of practice in its initial stages in lifted weight experiments. The results show that the effect of this progressive practice is to increase the values of the coefficients of precision of both the lighter and heavier judgments and to decrease the values of both the interval of uncertainty and, to a less degree, of the point of subjective equality. The effects of this progressive practice are stronger at the beginning of the experimental series and decrease, at first rapidly and then more slowly, as the experimentation continues. In view of the effects of this influence of progressive practice in its initial stages, we recommended that, for anthropometric studies, not less than fifty judgments on each of five pairs of weights should be considered sufficient for the determination of a limen. This recommendation was our conclusion from comparing the limen values calculated from the data of the first 25, 50, and 100 judgments on each of 5 comparison pairs of weights. Although our recommendation of 50 judgments does not by any means eliminate the effects of this influence, still we look upon it as a *compromise* between time and accuracy, both of which are important factors for the anthropometrist and clinician.

Dr. Boring has opposed these recommendations.[2] In the first place Boring suggests that we are interested not in thresholds themselves but rather in *differences between* thresholds. Obviously then "the greater the difference we are seeking to establish, the fewer are the observations necessary to establish it." Hence we may determine in the first place the probable errors of each of the

[1] FERNBERGER, S. W. "The Effects of Practice in its Initial Stages in Lifted Weight Experiments and its Bearing upon Anthropometric Measurements," *Amer. J. of Psychol.*, 1916, 27, 261–272.

[2] BORING, E. G. "The Number of Observations upon Which a Limen May Be Based," *Amer. J. of Psychol.*, 1916, 27, 315–319.

two limens which we wish to compare and from these we may readily calculate the probable correctness of the difference between the two limens. This Boring calculates for a series of observations of dual sensitivity of the forearm and eyelid, a case where we might expect a large difference. Boring calculates the probable correctness of the difference in series of ten observations, and most of these have great significance, several indeed giving values of absolute mathematical certainty (unity). Boring then suggests that in dealing with the unpracticed observer, we must have a practice series until the reactions of the observer settle down to a point where the values of his coefficients of precision (h) reach magnitudes so that the probable correctness of the difference will become significant.

There are several points in connection with Boring's discussion which might be given further consideration. In the first place we wish to disclaim any intention of applying our recommendation of 50 judgments on each of five pairs of stimuli outside of the field of lifted weights. The actual number of observations necessary for the determination of a threshold may vary considerably for the different modalities of sensation, and even for different experimental arrangements within the same modality. Hence one must make an empirical determination for each experimental arrangement as we have done in the case of the determination of the difference threshold for lifted weights by the method of constant stimuli. But obviously the general principle remains even though the actual number of determinations might vary from case to case. We furthermore wish to state again that our recommendation was a mere compromise between accuracy and time, and we by no means believed that we were eliminating the influence of this factor by any such course.

To take up the different points suggested by Boring, we would in the first place heartily recommend the calculation of the probable correctness of the difference between two limens in the manner that the author suggests. But we believe that such a mathematical treatment has only more or less limited applicability. Let us first consider Boring's statement that we are interested, not in limen values, but in differences between limens. Theoretically this concept is unquestionably true. But it would superficially appear to be untrue from the practical standpoint. Let us consider the clinical case. For example Grabfield[1] determined the threshold

[1] GRABFIELD, G. P. "Variations in the Sensory Threshold for Faradic Stimulation in Psychopathic Subjects," *Bost. Med. & Surg. J.*, 1914, 171, 883–886.

for 135 psychopathic cases and found that these averaged 223 *B* units for the limen as determined by the Martin method for the measurement of induction shocks. He states that a threshold greater than 175 *B* units may be considered as definitely pathological. If this be true, and let us grant for the sake of argument that it is, then the clinician would appear to be *practically* interested in the fact that a certain subject gives a limen of 200 *B* units. The fact that his limen is 200 would certainly be of great practical interest to the patient.

Theoretically, however, it is quite another matter. Theoretically we are interested in comparing this individual threshold with a general *norm*, which has previously been empirically determined. But meanwhile what of Boring's method of calculation of the probable correctness of the difference between this individual limen and the general norm? Let us remember that the probable correctness of the difference between two limens is based upon the probable errors of each of them. It is an easy matter to determine the probable error of the limen which we have just determined, but what of that for the norm? Such a norm must be obtained by averaging the values of the thresholds of a relatively large number of subjects with a relatively large number of determinations from each. In such a case the work of obtaining the probable error of this average threshold would be a very laborious affair. It may, of course, be argued that, once this probable error of the norm has been obtained, we would have it for all time and hence could use it directly in all calculations for the probable correctness of the difference, provided of course that the individual threshold was obtained under identical experimental conditions.

Also, in the case of the clinician, we are using in the same calculation the probable error of a limen value obtained on the basis of a few experimental data, and the probable error—that of the norm—obtained on the basis of extensive empirical data. In other words, in the case of the norm we hope that our data are extensive enough so that all chance influences which may effect the determination will have cancelled one another and therefore will be eliminated. It is only on the basis of this belief that we are willing to consider that the value is a norm. But we can have no such assurance about the other threshold except by observing the size of the probable error—that same value which we are going to use in our future calculation of the probable correctness of the difference between the two thresholds.

In those cases where we are interested in the difference between limens, as in the case of Boring's example of the dual sensitivity of forearm and eyelid, we are also interested in the *amount* of that difference. It is true, for example, that we are interested in learning that the savage is more sensitive than the civilized man, but we are also interested in learning that the savage is *twice* as sensitive. We would point out that Boring's calculation of the probable correctness of the difference gives a true mathematical expression for the significance of the first of these questions only. It may well be that there is a significant difference between the two thresholds but this does not imply that the *amount* of difference obtained is correct with the same probability.

Finally let us return to the case where the individual threshold is compared with a general norm. The norm, it will be remembered, should be obtained by averaging the limen values from a large number of observations on each of a large number of subjects. From such a method only may we hope to eliminate the chance influences which may effect both the individual subject and the differences between subjects. In that case we find ourselves exactly where we started. The question which confronts us is: How many determinations are we going to require from each of our subjects whose results are to be utilized in the determination of the norm? We have already given a partial answer to this problem when we have stated that, in the case of lifted weights due to the effects of progressive practice, not less than 50 judgments on each of five comparison pairs of weights should be considered sufficient for the determination of a limen.

SAMUEL W. FERNBERGER

CLARK UNIVERSITY

BOOKS RECEIVED

FRANK, H. *Psychic Phenomena, Science and Immortality.* (2nd ed.) Boston: Sherman, French, 1917. Pp. xxxvi+556. $2.50.

PATTERSON, W. M. *The Rhythm of Prose.* New York: Columbia Univ. Press. Pp. xxiv+193. $1.50.

DEWEY, J. & OTHERS. *Creative Intelligence.* New York: Holt, 1917. Pp. v+467. $2.00.

FLOURNOY, T. *The Philosophy of William James.* (Trans. by E. B. Holt & W. James, Jr.) New York: Holt, 1917. Pp. ix+246. $1.30.

LEUBA, J. H. *The Belief in God and Immortality.* Boston: Sherman, French, 1916. Pp. xvii+340. $2.00.

TRABUE, M. R. *Completion-Test Language Scales.* New York: Teachers Coll., 1916. Pp. 118. $1.50.

THORNDIKE, E. L., MCCALL, W. A., & CHAPMAN, J. C. *Ventilation in Relation to Mental Work.* New York: Teachers Coll., 1916. Pp. 83. $1.00.

MCDONALD, R. A. F. *Adjustment of School Organization to Various Population Groups.* New York: Teachers Coll., 1915. Pp. 145. $1.50.

WOODY, C. *Measurements of Some Achievements in Arithmetic.* New York: Teachers Coll., 1916. Pp. 63. $1.00.

MEAD, C. D. *The Relations of General Intelligence to Certain Mental and Physical Traits.* New York: Teachers Coll., 1916. Pp. 117. $1.50.

STECHER, L. I. *The Effect of Humidity on Nervousness and on General Efficiency.* New York: Science Press, 1916. Pp. v+94. 90 cents.

EVANS, J. E. *The Effect of Distraction on Reaction Time.* New York: Science Press, 1916. Pp. iii+106. $1.00.

HAMILTON, G. V. *A Study of Perseverence Reactions in Primates and Rodents.* Behavior Monog., 1916, 3, No. 2 (Whole No. 13). Pp. iv+65. 75 cents.

COE, G. A. *The Psychology of Religion.* Chicago: Univ. of Chicago, 1916. Pp. xv+365. $1.50.

LEE, R. I. *Health and Disease, Their Determining Factors.* Boston: Little, Brown, 1917. Pp. xi + 378. $1.75.

ANON. *India's Appeal to Canada.* Toronto: Canada India League.

NOTES AND NEWS

A NEW journal, *Mental Hygiene*, is being issued quarterly under the direction of the National Committee for Mental Hygiene, presenting non-technical studies of mental matters in relation to life problems.

DR. THOMAS H. HAINES, of the Ohio State University, has been granted five months' leave of absence to make a survey of mental

defectives in Kentucky, under the auspices of the National Committee for Mental Hygiene and the Rockefeller Foundation.

ANNOUNCEMENT is made of the appearance, about May 15, of the first number of a new bi-monthly journal, *Psychobiology*, which will be devoted to the overlapping portions of the fields of psychology, biology, and pharmacology. Professor Knight Dunlap, of the Johns Hopkins University, is the responsible editor.

DR. CARL C. BRIGHAM, instructor in psychology at Princeton University, has resigned his position to enter the Canadian service during the war. Dr. John J. B. Morgan has been appointed to fill the vacancy.

THE following items have been taken from the press:

PROFESSOR G. O. FERGUSON, JR., of William and Mary College, has been appointed associate professor of psychology and education in Colgate University.

DR. JOHN E. RUSSELL, of Williams College, died on February 26, in his seventieth year.

EXPERIMENTAL psychology has been made an obligatory subject for the licentiate in biological sciences in the University of Geneva, and the faculty of sciences has established a doctorate in the psychological sciences. Psychology is also included for the licentiate in the new faculty of economic and social sciences.

DR. GEORGE H. MAKUEN, of Philadelphia, has died at the age of sixty-one years. Dr. Makuen was widely known for his work on speech defects.

DR. GREGORY D. WALCOTT, of Hamline University, has been given a year's leave of absence to teach psychology and logic in the Government College at Tsing Hua, China.

THE Criminal Court of Chicago is to have a Psychopathic Institute as an extension of the Juvenile Psychopathic Institute. Aid has been obtained for the establishment of the institute from the Rockefeller Foundation, and Dr. Herman Adler is to be the director.

WORK has been begun with lectures and demonstrations at the new institute for experimental psychology at Constantinople, under the direction of Professor Anschütz, formerly of Kiel.

THE death of Professor J. Déjerine, of Paris, has been announced. Professor Déjerine was in his sixty-eighth year, and one of the foremost of the relatively large group of neurologists at Paris. He is well known for his contributions to clinical neurology, to anatomy and to neuropathology.

DR. LOUIE WINFIELD WEBB has been appointed instructor in psychology and education in Northwestern University.

DR. ELIZABETH L. WOODS has resigned as assistant professor of psychology at Vassar College to become director of Child Welfare at Pasadena, California.

THE California State Board of Health has prepared a bill providing for the establishment of a state psychopathic hospital in San Francisco, near the University of California Medical School.

A MEDICAL clinic for delinquent, nervous, subnormal, and abnormal children has been opened in the university hospital of the University of Minnesota.

DR. J. H. COFFIN, of Earlham College, is taking charge of the courses of Professor S. P. Hayes, of Mount Holyoke College, during the second semester.

PUBLISHERS' NOTICE

Owing to the greatly increased cost of production we are compelled to raise the price of our publications. Beginning July 1, 1917, the subscription to the REVIEW and BULLETIN will be $6 and to the JOURNAL $3.25, with other rates corresponding. The complete list will be found on the inside cover page.

PSYCHOLOGICAL REVIEW COMPANY